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AUTO-GENERATORS OF HOT GASES UNDER PRESSURE, AND IN PARTICULAR IN FREE PISTON AUTO-GENERATORS

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Fig. 1.

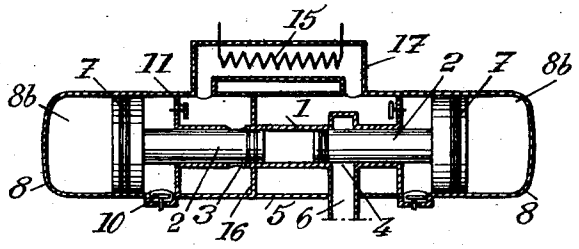


Fig. 2.

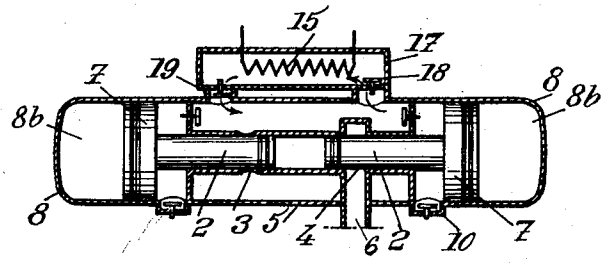
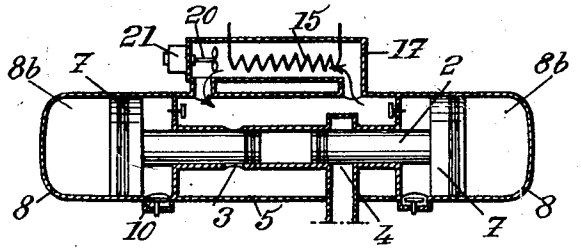


Fig. 3.



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AUTO-GENERATORS OF HOT GASES UNDER PRESSURE, AND IN PARTICULAR IN FREE PISTON AUTO-GENERATORS

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Original application July 20, 1953, Serial No. 369,147, now Patent No. 2,783,750, dated March 5, 1957. Divided and this application January 16, 1957, Serial No. 634,507

Claims priority, application France January 30, 1953

10 Claims. (Cl. 123—46)

The present invention relates to auto-generators of hot gases under pressure, that is to say to machines including on the one hand, an internal combustion power portion working preferably on the two-stroke cycle and according to the diesel principle and, on the other hand, a piston compressor portion driven by the power portion and serving to compress air, at least most of this air and generally the whole of it serving to the feeding and the scavenging of the power portion. This power portion supplies, through its outlet orifices, gases under pressure constituted by scavenging air mixed with the combustion gases uncompletely expanded in the power portion.

My invention is more especially but not exclusively concerned with such auto-generators having free pistons, that is to say including pistons at least one of the dead center positions of which is variable. The invention is still more particularly concerned with auto-generators the compressor portion of which compresses air during the inward stroke of the piston, that is to say during the stroke which constitutes for the power portion the compression stroke, the air thus compressed being discharged, before the end of said inward stroke, directly into a reservoir adjacent to this compressor portion and which generally surrounds the cylinder of the power portion, whereby this reservoir constitutes the casing of the machine.

The chief object of my invention is to provide a machine of the type above referred to which is better adapted than those existing up to the present time to meet the requirements of practice.

According to my invention, the above mentioned power cylinder is surrounded by an annular casing into one end of which air under pressure is fed from said compressor cylinder, past suitable valve means interposed between said compressor cylinder and said casing, and a chamber located on the outside of said casing forms a shunt passage between said end of said casing and the other end thereof, the air that flows through said shunt passage being cooled through suitable means.

Preferred embodiments of my invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example, and in which:

Each of Figs. 1 to 3 diagrammatically shows in longitudinal section a free piston auto-generator made according to one of three different embodiments of my invention, respectively.

In the following description, it will be supposed that the free piston auto-generator is arranged so that air is compressed during the inward stroke of the compressor element.

Such an auto-generator includes, in known fashion, a power cylinder **1** in which are fitted two power pistons **2** having opposed movements. The displacements of these two pistons are kept in synchronism by means of a conventional synchronizing mechanism, not shown by the drawings. These power pistons, when they are close to their outer dead center position, open inlet ports **3** and outlet ports **4** provided in the wall of power cylinder **1**, it being supposed, as it is generally the case, that the power portion of the machine works on the two-stroke diesel cycle. Fuel is injected when the power pistons **2** are close to their inner dead center position, by means of one or several injectors disposed in the transverse middle plane of the machine and which are not shown by the drawings.

The power portion which has just been described is disposed inside a casing **5** through which extends an exhaust conduit **6** in communication with the discharge orifices **4** of the power cylinder **1**.

Each of the power pistons **2** is rigid with a compressor piston **7** and each of these compressor pistons is working in a compressor cylinder **8**. The two cylinders **8** are located on either side of casing **5** and each of them is separated from this casing by a partition **9**. Each cylinder **8** is divided into two chambers by the compressor piston **7** present therein. Each chamber **8***a* constitutes the compressor cylinder proper where air drawn into this chamber through valves **10** is compressed during the inward stroke of pistons **2—7**, this air being discharged at the end of this stroke through discharge valve into casing **5**.

The outer chambers **8***b* of said cylinders **8** contain air cushions which store up energy during the outward stroke of pistons **2—7** (taking place under the effect of the combustion of fuel in power cylinder **1**) and give back this energy to pistons **7—2** during the inward stroke thereof so as to make this last mentioned stroke possible.

It is well known that the power of a given auto-generator is essentially determined by the temperatures of the hot gases under pressure which flow out from the generator through exhaust conduit **6**, and which are constituted by scavenging air which has flown through the power cylinder and by the combustion gases which have mixed with this scavenging air and the pressure of which corresponds to the pressure with which the scavenging air enters into said power cylinder.

In order to increase the power per unit of mass, without exceeding the admissible temperature, of an auto-generator the compressor piston of which has been fed with air pre-compressed by a blower, it has already been proposed to cool down the air, during its travel from the blower to the intake of the compressor cylinder of the auto-generator. However, in view of the relatively low pre-compressing of the air before its entrance into the compressor cylinder of the auto-generator and in view, consequently, of the slight increase of temperature of said air due to pre-compression, a really efficient cooling of this air would have required rather complicated installations which would have considerably increased the cost and dimensions of the auto-generator. Furthermore, this known arrangement was applicable only when the compressor cylinder or cylinders of the auto-generator was or were fed with precompressed air.

In order to avoid these drawbacks and according to the main feature of my invention, cooling means are provided in an elongated chamber forming a shunt passage between two points of casing **5** spaced apart longitudinally from each other, for instance between the two ends of said casing **5**, whereby air on its way from said compressor toward the intake **3** of the power cylinder **1** is cooled as it flows through said shunt passage.

I thus obtain a very efficient cooling action by making use of relatively simple cooling means, which do not increase the volume of the auto-generator or at least increase it but very little.

Of course, such an arrangement can be made in many different ways.

Several embodiments of such an auto-generator will now be described with reference to the drawings. All these embodiments are concerned with an auto-generator the compressor portion of which compresses air during the inward stroke of the piston and discharges this air directly into casing 5 through holes provided in a partition provided between the compressor cylinder and said casing 5, said holes being provided with suitable valve means.

In the embodiments shown by the drawings, I cause the air under pressure which is to be cooled to flow along a cooling device constituted by a coil 15 in which a cooling liquid is circulated, said cooling device being located inside an elongated chamber 17 forming the above mentioned shunt passage. The energy necessary for causing this air to flow through said passage 17 is supplied, in the auto-generators illustrated by Figs. 1 and 2, by the compressor-pistons 7 themselves, during the strokes thereof which discharge the compressed air into the casing. Thus, in the construction illustrated by Fig. 1, the inside of the casing is divided into two chambers, by a transverse partition 16 located between the inlet ports 3 and the exhaust ports 4 and very close to the inlet ports 3.

The two chambers thus formed inside casing 5 are connected with the respective ends of passage 17. With such an arrangement, a substantial portion of the air discharged past valves 11, during the inward stroke of pistons 7 is compelled to flow into passage 17. When one of the power pistons 2 clears ports 3, the air present in this space 17 and even a portion of the air present in the chamber of the casing which is located on the side of the exhaust ports 4 enter power cylinder 1, after having flown along the outer walls of cooling coil 15.

In the construction illustrated by Fig. 2, the passage 17 in which cooling coil 15 is located communicates at one of its ends with the inside of casing 5 through a valve 18 which opens only in the direction from the casing toward passage 17, and at the other end, through a valve 19 which opens only in the opposite direction. Preferably, valve 18 is located on the side of the exhaust ports 4 of cylinder 1 and valve 19 on the side of the inlet ports 3 of this cylinder. When compressed air is discharged from the compressor cylinder into casing 5, a portion of this air enters passage 17, through valve 18, and flows out therefrom after cooling, through valve 19, when one of the power pistons 2 clears the inlet ports 3. A portion of the air therefore flows along the path shown on Fig. 2 by the arrows.

In the auto-generator shown by Fig. 3, the flow of air along cooling coil 15 is obtained by means of a fan 20 driven for instance by an electric motor 21. Passage 17 communicates at both of its ends constantly with the inside of casing 5. Fan 20 creates an air flow along cooling coil 15 and the direction of this air flow is advantageously that illustrated in Fig. 3 by the arrows.

The use of an external source (fan 20 and motor 21) to produce the air circulation along cooling coil 15 has the advantage of an easy adjustment of the cooling action. As a matter of fact, this adjustment may be obtained by adjusting the speed of the fan. It is thus possible to obtain air at a maximum temperature which is approximately constant.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims. The present application is a division of my U. S. patent application Ser. No. 369,147, filed July 20, 1953, which has become Patent No. 2,783,750.

What I claim is:

1. An auto-generator of hot gases under pressure which comprises, in combination, an internal combustion engine power cylinder provided with at least one air intake port and one exhaust port located at different points along said power cylinder, a power piston freely movable in said cylinder, means for collectnig the hot gases under pressure from said exhaust port, an air compressor cylinder in line with said power cylinder, a compressor piston rigid with said power piston and fitting slidably in said compressor cylinder, a closed annular casing surrounding said power cylinder, valve means for letting compressed air flow unidirectionally from said compressor cylinder into said casing, an elongated chamber extending on the outside thereof and forming a shunt passage between two points of said casing spaced apart longitudinally from each other, means for causing at least a portion of the air in said casing to travel through said passage, and air cooling means in said passage.

2. An auto-generator of hot gases under pressure which comprises, in combination, an internal combustion engine power cylinder provided with at least one air intake port and one exhaust port located at different points along said power cylinder, a power piston freely movable in said cylinder, means for collecting the hot gases under pressure from said exhaust port, an air compressor cylinder in line with said power cylinder, a compressor piston rigid with said power piston and fitting slidably in said compressor cylinder, a closed annular casing surrounding said power cylinder, valve means for letting compressed air flow unidirectionally from said compressor cylinder to one end of said casing, an elongated chamber extending on the outside of said casing forming a shunt passage between said end of said casing and the other end thereof, means for causing air under pressure to be fed from said compressor cylinder through said passage to the second mentioned end of said casing, and air cooling means in said passage.

3. An auto-generator of hot gases under pressure which comprises, in combination, an internal combustion engine power cylinder provided with at least one air intake port and one exhaust port located at different points along said power cylinder, a power piston freely movable in said cylinder, means for collecting the hot gases under pressure from said exhaust port, an air compressor cylinder in line with said power cylinder, a compressor piston rigid with said power piston and fitting slidably in said compressor cylinder, a closed annular casing surrounding said power cylinder, valve means for letting compressed air flow unidirectionally from said compressor cylinder to one end of said casing, an elongated chamber extending on the outside of said casing forming a shunt passage between the ends of said casing, a partition dividing said casing transversely to said power cylinder, said partition being located between said intake and exhaust ports, and air cooling means in said passage.

4. An auto-generator of hot gases under pressure which comprises, in combination, an internal combustion engine power cylinder provided with at least one air intake port and one exhaust port located at different points along said power cylinder, a power piston freely movable in said cylinder, means for collecting the hot gases under pressure from said exhaust port, an air compressor cylinder in line with said power cylinder, a compressor piston rigid with said power piston and fitting slidably in said compressor cylinder, a closed annular casing surrounding said power cylinder, valve means for letting compressed air flow unidirectionally from said compressor cylinder to one end of said casing, an elongated chamber extending on the outside of said casing forming a shunt passage between the ends of said casing, a check valve in the opening of said passage into said casing which is nearer to said intake port, said check valve opening toward the inside of said casing, a check valve in the other opening of said passage into said casing,

said last mentioned check valve opening toward the inside of said passage, and air cooling means in said passage.

5. An auto-generator of hot gases under pressure which comprises, in combination, an internal combustion engine power cylinder provided with at least one air intake port and one exhaust port located at different points along said power cylinder, a power piston freely movable in said cylinder, means for collecting the hot gases under pressure from said exhaust port, an air compressor cylinder in line with said power cylinder, a compressor piston rigid with said power piston and fitting slidably in said compressor cylinder, a closed annular casing surrounding said power cylinder, valve means for letting compressed air flow unidirectionally from said compressor cylinder to one end of said casing, an elongated chamber extending on the outside of said casing forming a shunt passage between the ends of said casing, both ends of said passage communicating freely with said casing, a fan in said passage for causing air to circulate therethrough from one end toward the other, a motor for driving said fan, and air cooling means in said passage.

6. An auto-generator of hot gases under pressure which comprises, in combination, at least one internal combustion power cylinder, two power pistons freely movable in opposed directions in said cylinder, said power cylinder being provided with at least one air intake port, two compressor cylinders in line with said power cylinder on either side therewith, two compressor pistons, rigid with said power pistons, fitting slidably in said compressor cylinders, a closed annular casing surrounding said power cylinder and connected with the outputs of said compressor cylinders, valve means for letting compressed air flow unidirectionally from said compressor cylinders to said casing, said power cylinder being provided with an exhaust port, a conduit for collecting the hot gases under pressure supplied from said exhaust port, said conduit extending to the outside of said casing, an elongated chamber on the outside of said casing forming a shunt passage between the two ends thereof respectively, means for causing air from said casing to circulate through said passage and means for cooling said passage.

7. An auto-generator of hot gases under pressure which comprises, in combination, at least one internal combustion power cylinder, two power pistons freely movable in opposed directions in said cylinder, said power cylinder being provided with at least one air intake port, two compressor cylinders in line with said power cylinder on either side therewith, two compressor pistons, rigid with said power pistons, fitting slidably in said compressor cylinders, a closed annular casing surrounding said power cylinder and connected with the outputs of said compressor cylinders, valve means for letting compressed air flow unidirectionally from said compressor cylinders to said casing, said power cylinder being provided with an exhaust port, a conduit for collecting the hot gases under pressure supplied from said exhaust port, said conduit extending to the outside of said casing, an elongated chamber on the outside of said casing forming a shunt passage between the respective ends thereof, a partition dividing said casing transversely to said power cylinder, said partition being located between said intake and exhaust ports of the power cylinder, and a liquid cooled coil disposed in said chamber.

8. An auto-generator of hot gases under pressure which comprises, in combination, at least one internal combustion power cylinder, two power pistons freely movable in opposed directions in said cylinder, said power cylinder being provided with at least one air intake port, two compressor cylinders in line with said power cylinder on either side therewith, two compressor pistons, rigid with said power pistons, fitting slidably in said compressor cylinders, a closed annular casing surrounding said power cylinder and connected with the outputs of said compressor cylinders, valve means for letting compressed air flow unidirectionally from said compressor cylinders to said casing, said power cylinder being provided with an exhaust port, a conduit for collecting the hot gases under pressure supplied from said exhaust port, said conduit extending to the outside of said casing, an elongated chamber on the outside of said casing forming a shunt passage between the respective ends thereof, a valve opening toward the inside of said passage interposed between one end of said casing and the corresponding end of said passage, a valve opening toward the inside of said casing interposed between the other end of said passage and the corresponding end of said casing, and a liquid cooled coil in said chamber.

9. An auto-generator according to claim 8, in which the first mentioned valve is located on the same side of the middle of said casing where is located said exhaust port.

10. An auto-generator of hot gases under pressure which comprises, in combination, at least one internal combustion power cylinder, two power pistons freely movable in opposed directions in said cylinder, said power cylinder being provided with at least one air intake port, two compressor cylinders in line with said power cylinder on either side therewith, two compressor pistons, rigid with said power pistons, fitting slidably in said compressor cylinders, a closed annular casing, surrounding said power cylinder and connected with the outputs of said compressor cylinders, valve means for letting compressed air flow unidirectionally from said compressor cylinders to said casing, said power cylinder being provided with an exhaust port, a conduit for collecting the hot gases under pressure supplied from said exhaust port, said conduit opening to the outside of said casing, an elongated chamber on the outside of said casing forming a shunt passage between the respective ends thereof, a fan in said passage for causing air to circulate therethrough from one end thereof toward the other, a motor for driving said fan, and a liquid cooled coil in said chamber.

No references cited.